**4-94** Ethylene is heated at constant pressure. The specific volume change of ethylene is to be determined using the compressibility chart.

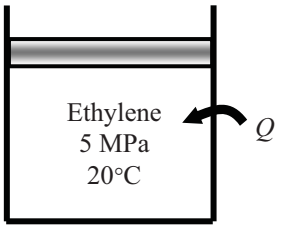
***Properties*** The gas constant, the critical pressure, and the critical temperature of ethane are, from Table A-1,

$$R = 0.2964 \text{ kPa·m}^3\text{/kg·K}, \qquad T_{cr} = 282.4 \text{ K}, \qquad P_{cr} = 5.12 \text{ MPa}$$

***Analysis*** From the compressibility chart at the initial and final states (Fig. A-15),

$$\left.\begin{aligned} T_{R1} &= \frac{T_1}{T_{cr}} = \frac{293 \text{ K}}{282.4 \text{ K}} = 1.038 \\ P_{R1} &= \frac{P_1}{P_{cr}} = \frac{5 \text{ MPa}}{5.12 \text{ MPa}} = 0.977 \end{aligned}\right\} \; Z_1 = 0.56$$

$$\left.\begin{aligned} T_{R2} &= \frac{T_2}{T_{cr}} = \frac{473 \text{ K}}{282.4 \text{ KR}} = 1.675 \\ P_{R2} &= P_{R1} = 0.977 \end{aligned}\right\} \; Z_1 = 0.961$$




The specific volume change is

$$\begin{aligned} \Delta v &= \frac{R}{P}(Z_2 T_2 - Z_1 T_1) \\ &= \frac{0.2964 \text{ kPa} \cdot \text{m}^3\text{/kg} \cdot \text{K}}{5000 \text{ kPa}}\left[(0.961)(473 \text{ K}) - (0.56)(293 \text{ K})\right] \\ &= \mathbf{0.0172 \text{ m}^3\text{/kg}} \end{aligned}$$